

What is claimed is:

1. A method of converting organic wastes to biodegradable thermoplastic materials including polyhydroxyalkanoates (PHAs) which comprises:
 - (a) treating the organic wastes with an acidogenic microbial population
5 in a first compartment to form volatile organic acids; and
 - (b) polymerizing the volatile organic acids by polyhydroxyalkanoate (PHA) producing microbial species in a second compartment to form PHAs,
wherein the volatile organic acids are transferred from the first to the second compartments via molecule diffusion across barriers.
- 10 2. The method as recited in claim 1, wherein the PHA producing microbial species are *R. eutropha* or *P. oleovorans*.
3. The method as recited in claim 1, wherein (a) occurs in an anaerobic environment and (b) occurs in an aerobic environment.
- 15 4. The method as recited in claim 1, wherein the PHAs contain 3 to 5 carbon monomers.
5. The method as recited in claim 1, wherein the PHAs contain 6 to 14 carbon monomers.
6. The method as recited in claim 1, wherein the PHA is poly(3-hydroxybutyrate) or poly(3-hydroxybutyrate-co-3-hydroxyvalerate).
- 20 7. The method as recited in claim 1, wherein the compartments are bioreactors.
8. A system for converting organic wastes to biodegradable thermoplastic materials including polyhydroxyalkanoates (PHAs) which comprises:

- (a) a first compartment, for acidogenesis of organic wastes; and
 - (b) a second compartment, for polymer synthesis by enriched cultures of polyhydroxyalkanoate (PHA) producing microbial species comprising *R. eutropha*, *P. oleovorans*, or mixtures thereof,
- 5 wherein the fermentative acids are transferred from the first to the second compartments through barriers.
9. The system as recited in claim 8, wherein the barriers prevent mixing of microbial cells, particulates and water in the two compartments.
- 10 10. The system as recited in claim 8, wherein the barriers maintain different culture conditions in the two compartments.